



Centre Spatial de Liège
Université de Liège



Assembly and tests status of the near-infrared spectrograph for the TIGRE telescope

5th TIGRE Workshop

20/12/2016

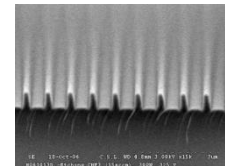




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■ Purpose of the analysis:

- Investigate if the spectrograph can be tested by observing bright stars with a smaller telescope (from Belgium).

■ Implemented telescope: *Celestron C8 S-GT*

- Diameter: 8" (~20cm)
- Focal length: 80"
- F# = 10

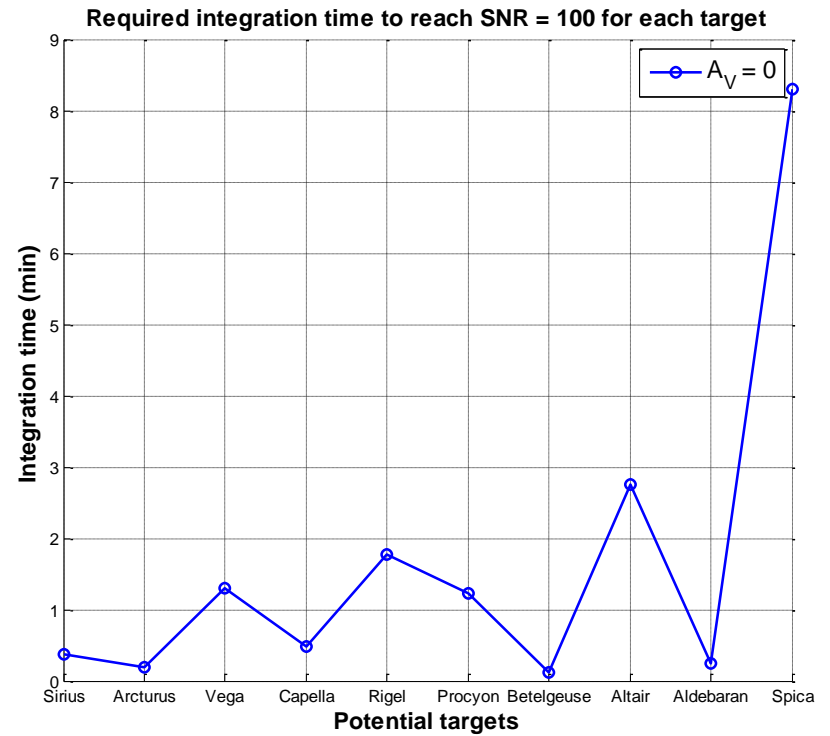
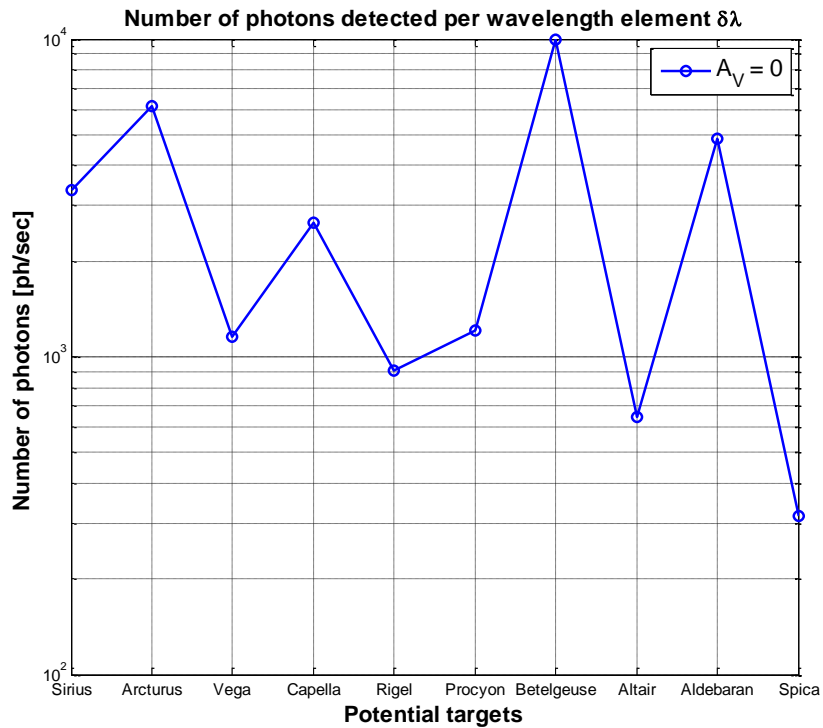
■ Potential targets:

	RA	DEC	sp type	V	J	Teff
Sirius	06 45 08.91728	-16 42 58.01	A1V	-1.46	-1.36	9.2kK
Arcturus	14 15 39.67207	+19 10 56.67	K0III	-0.05	-2.25	4.8kK
Vega	18 36 56.33635	+38 47 01.28	A0V	+0.03	-0.18	9.5kK
Capella	05 16 41.35871	+45 59 52.76	K0III+G1III	+0.08	-1.29	4.8+5.9kK
Rigel	05 14 32.27210	-08 12 05.89	B8I	+0.13	+0.22	11.2kK
Procyon	07 39 18.11950	+05 13 29.95	F5V	+0.37	-0.39	6.4kK
Betelgeuse	05 55 10.30536	+07 24 25.43	M2I	+0.42	-3.00	3.5kK
Altair	19 50 46.99855	+08 52 05.95	A7V	+0.76	+0.35	7.9kK
Aldebaran	04 35 55.23907	+16 30 33.48	K5III	+0.86	-2.10	4.0kK
Spica	13 25 11.57937	-11 09 40.75	B1III	+0.97	+1.50	24kK





Photometric budget – *Smaller telescopes*





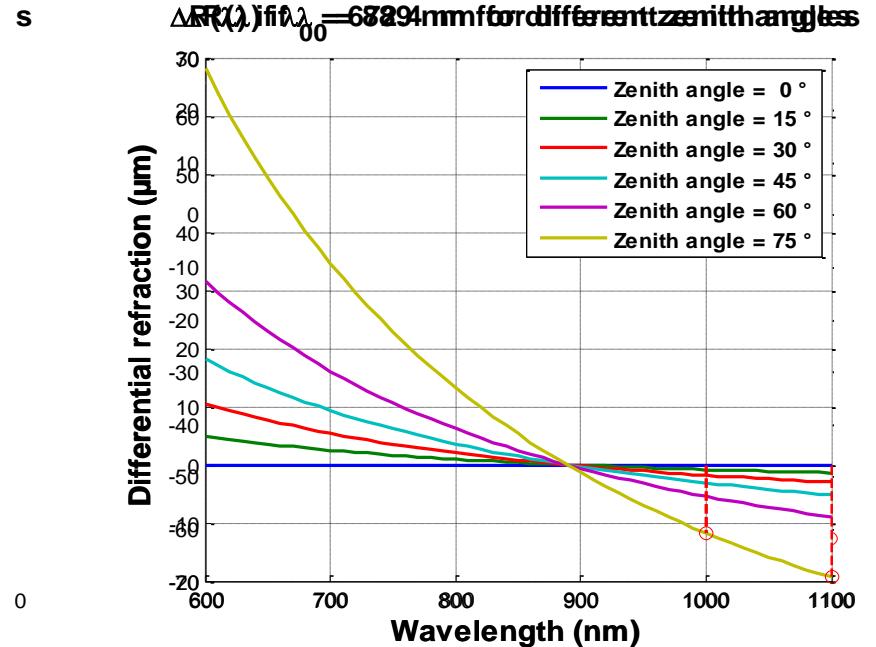
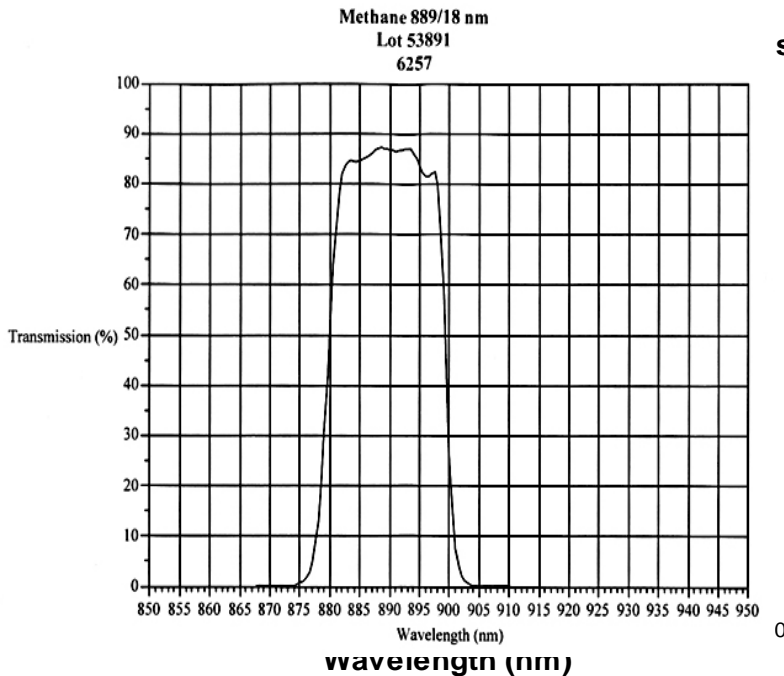
Pointing strategy – Differential refraction issue

- Star positioning system functioning:

- Align **VISIBLE** star and fiber images onto a camera
- NEAR-INFRARED** star image transmitted to fiber

- Differential refraction issue:

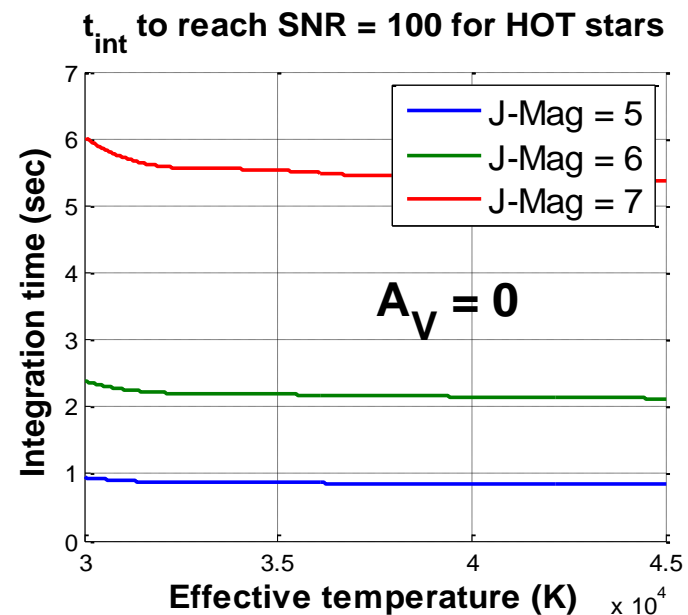
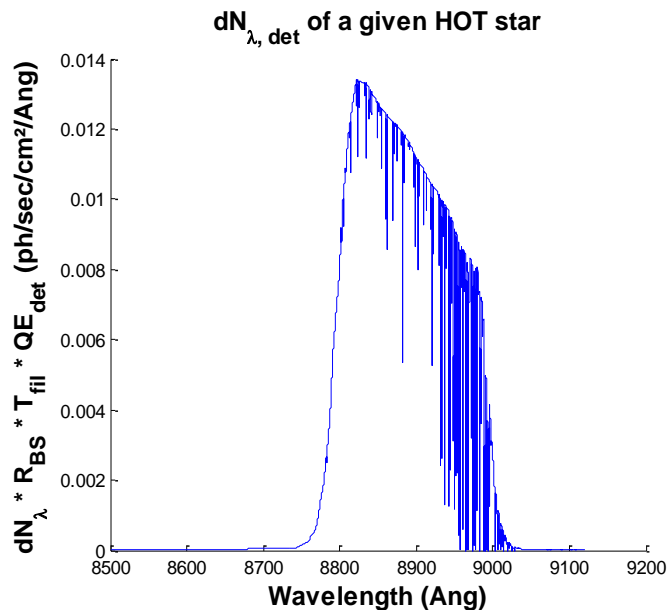
- VISIBLE** and **NIR** star images are spatially separated at telescope focal plane
- NIR** star image will not fall onto fiber core

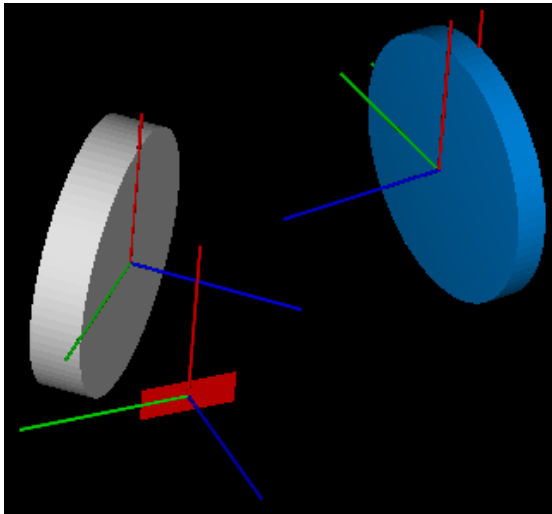
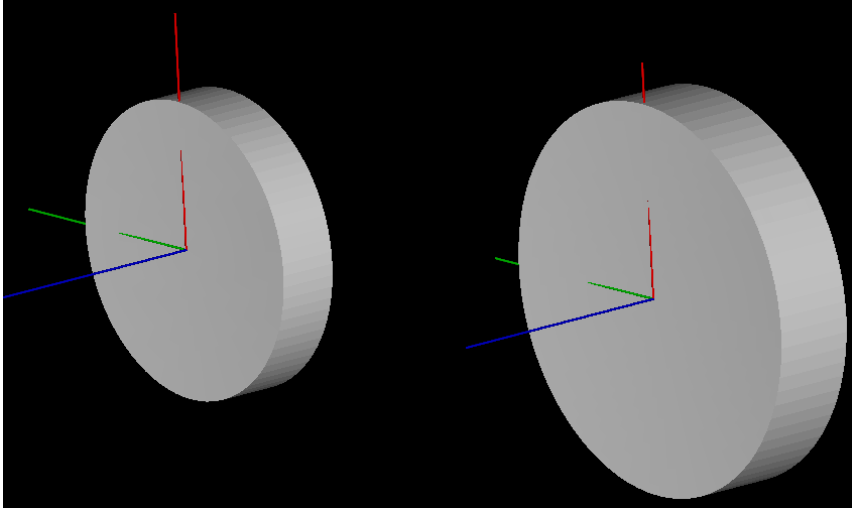




Specific photometric budget:

- Implements all wavelength-dependent optical performances of the star positioning system components
- Integrate the obtained profile over the methane filter waveband
- Calculate the required integration time to reach a given SNR

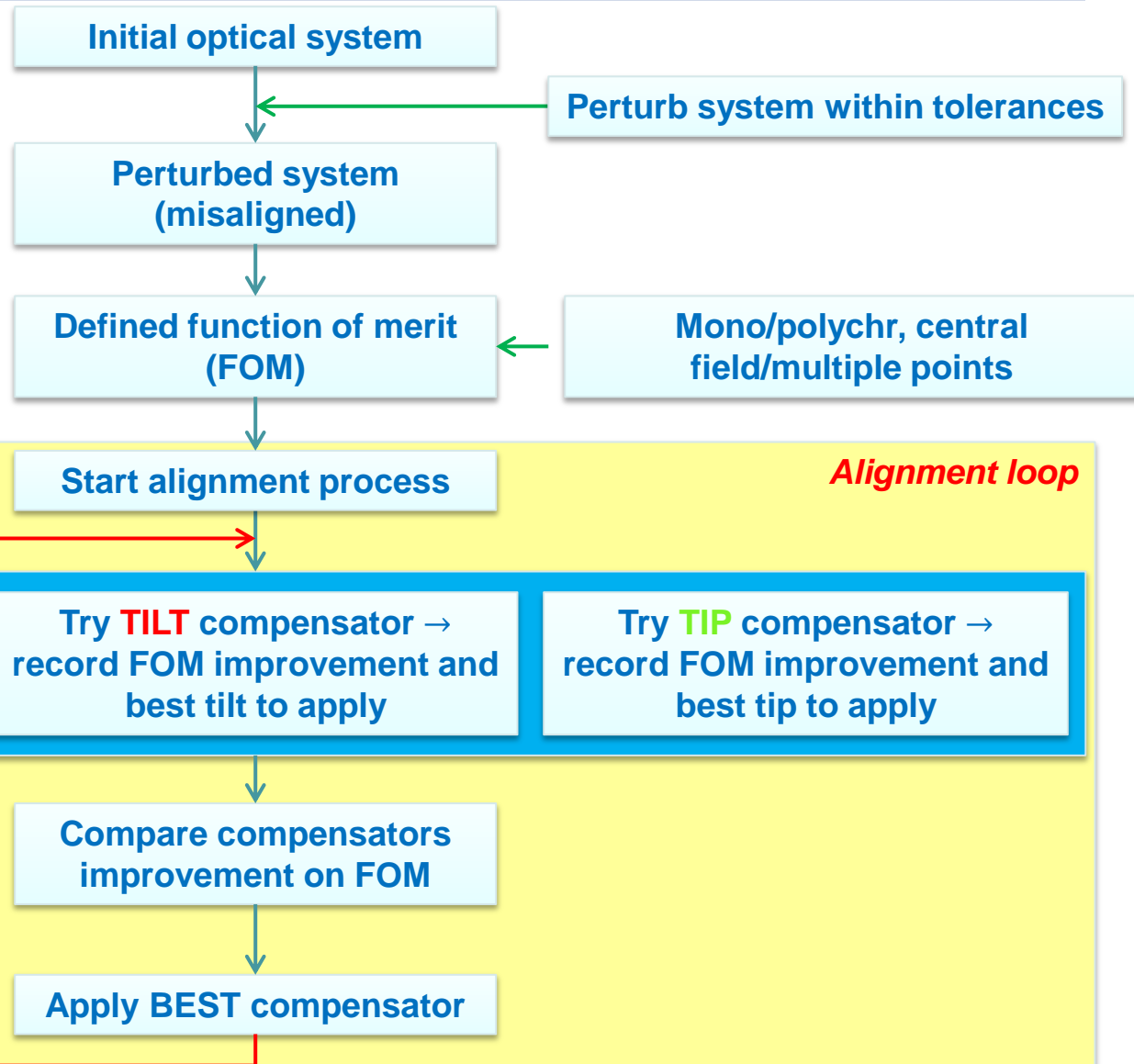




- Goal: check if alignment is feasible when starting from a perturbed system
- Calculate and implement local axes of all optical components to perturb elements
- Compensators on detector :
Focus, Tilt, Tip
- Range :
Focus: $\pm 1 \text{ mm by } 0.05 \text{ mm}$
Tilt: $\pm 1^\circ \text{ by } 0.05^\circ$
Tip: $\pm 1^\circ \text{ by } 0.05^\circ$



Alignment simulation - Algorithm

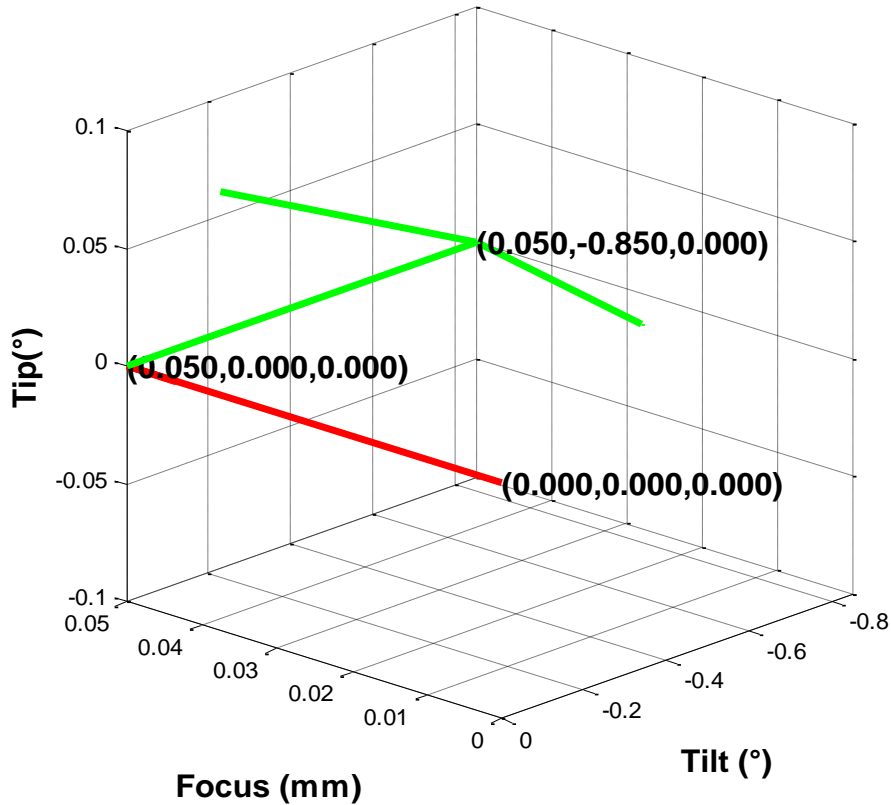




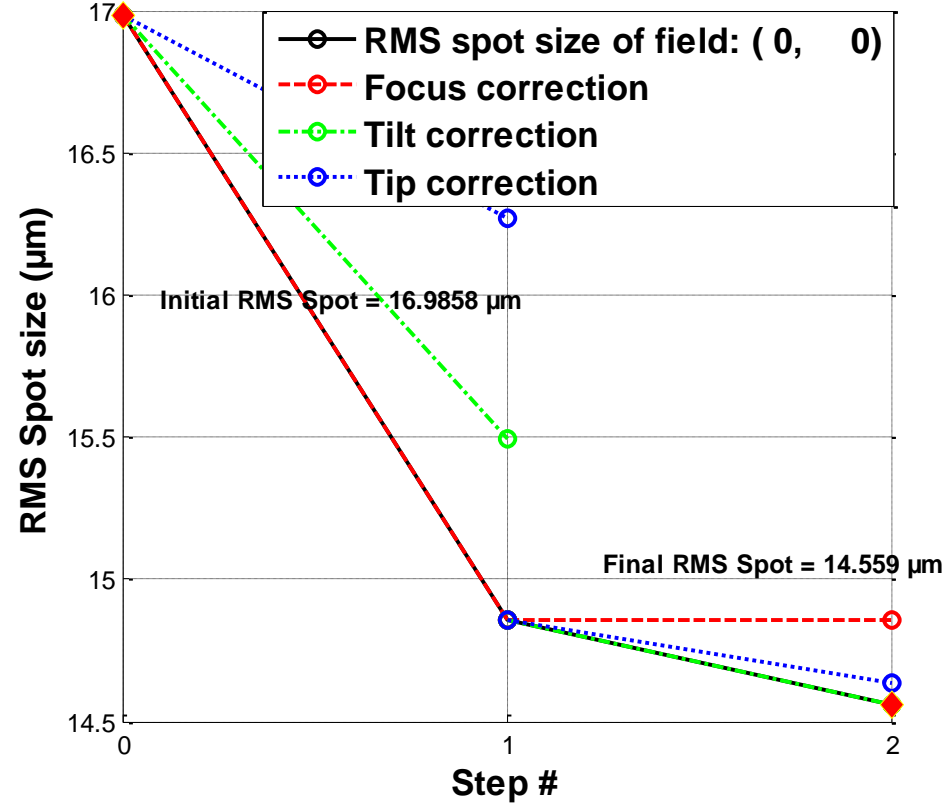
*Function of merit = Central fiber spot at a
single wavelength*



Compensators' evolution during alignment process

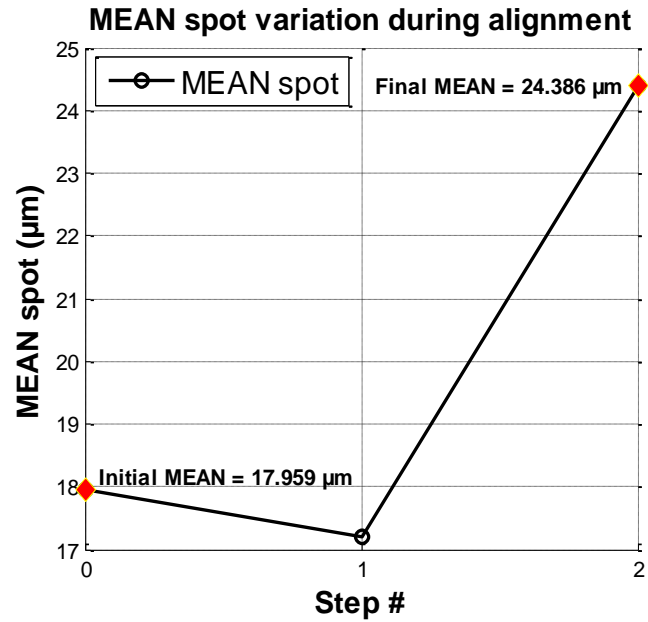


RMS spot variation of selected field during alignment

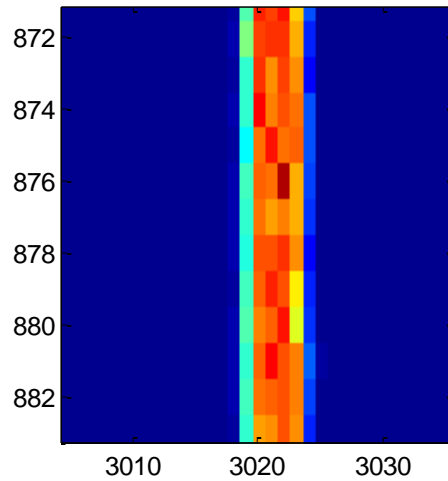




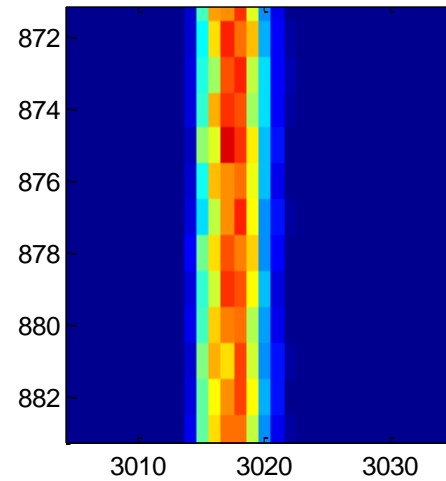
Alignment simulation – 1st case Results



Initial slit image



Final slit image

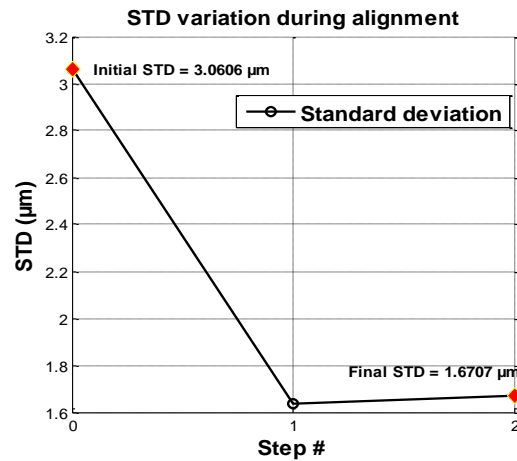
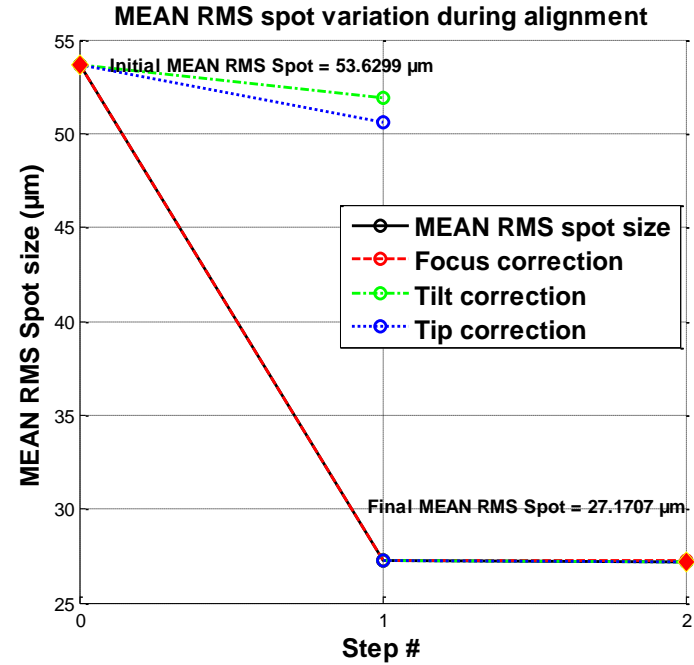
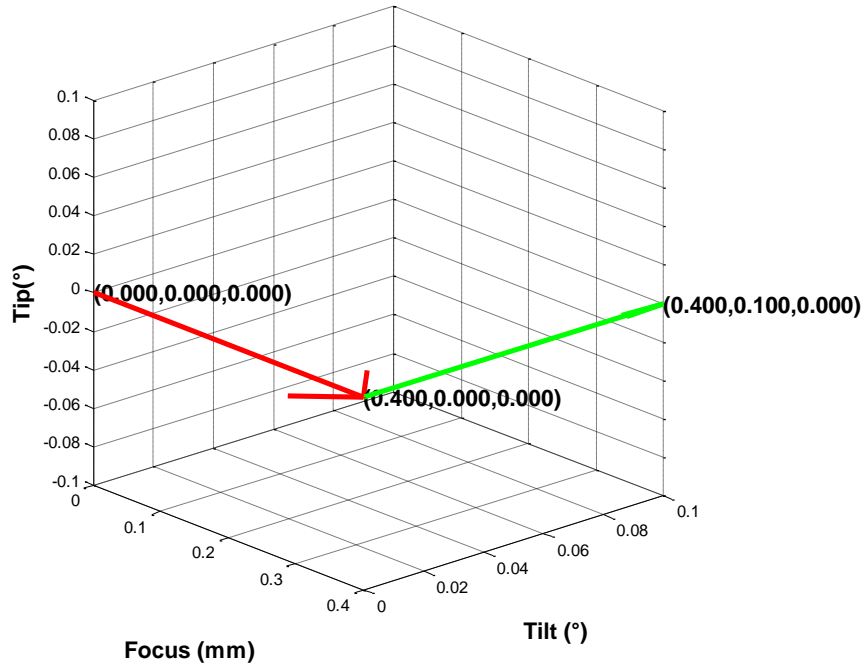




*Function of merit = Mean spot of several
fibers at multiple wavelengths*



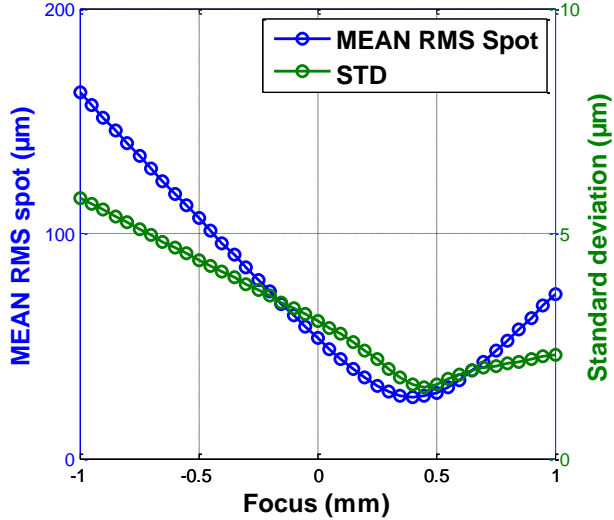
Alignment simulation – 2nd case results



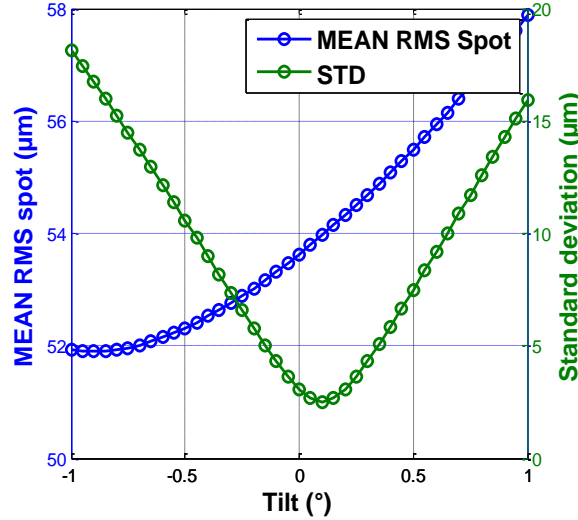


Alignment simulation – 2nd case results

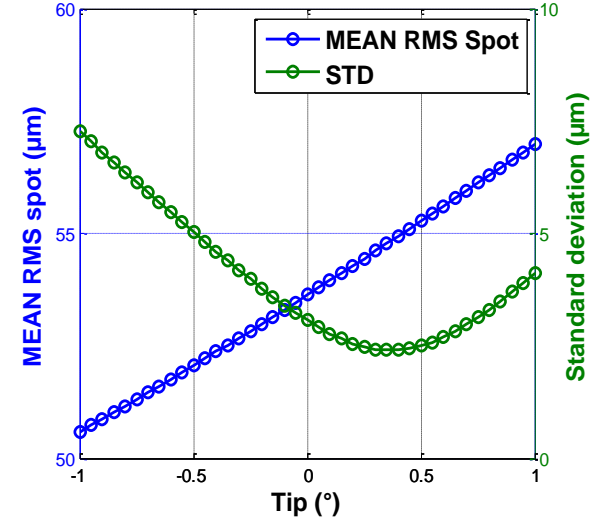
MEAN RMS spot and STD VS. FOCUS for STEP #1



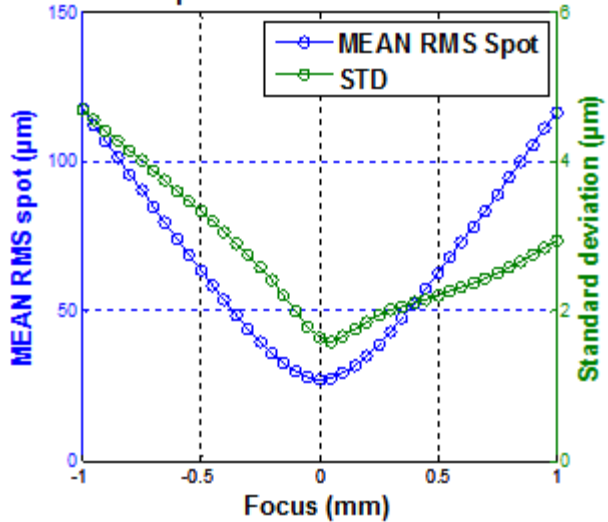
MEAN RMS spot and STD VS. TILT for STEP #1



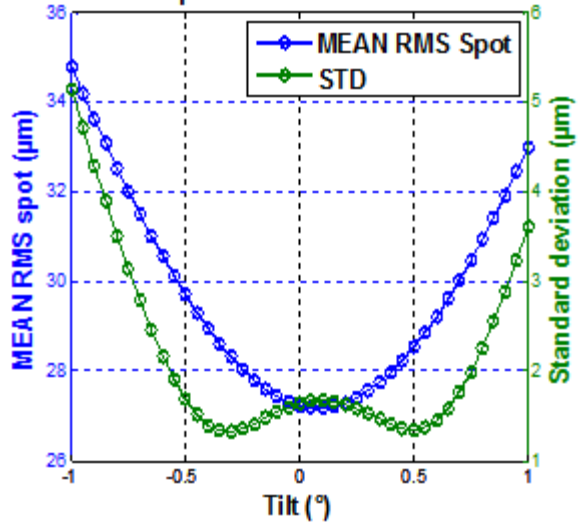
MEAN RMS spot and STD VS. TIP for STEP #1



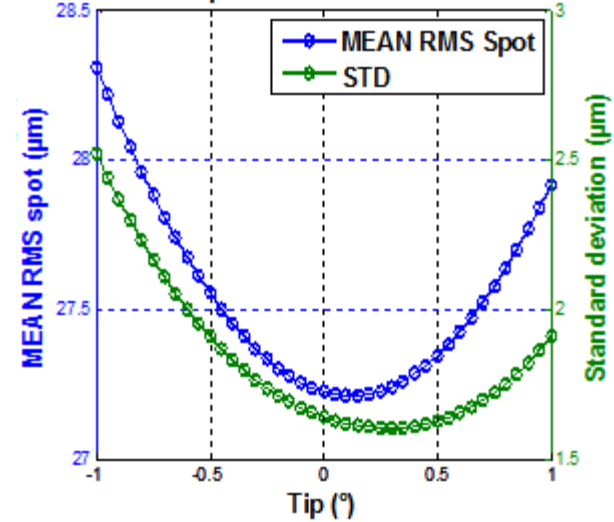
MEAN RMS spot and STD VS. FOCUS for STEP #2



MEAN RMS spot and STD VS. TILT for STEP #2



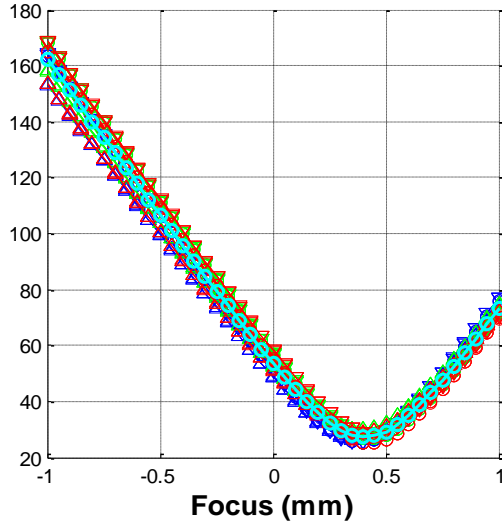
MEAN RMS spot and STD VS. TIP for STEP #2



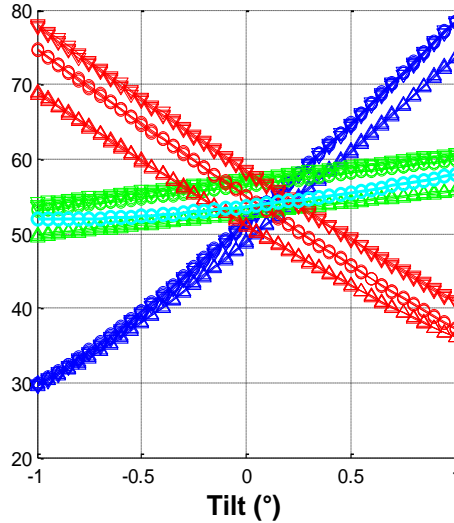


Alignment simulation – 2nd case results

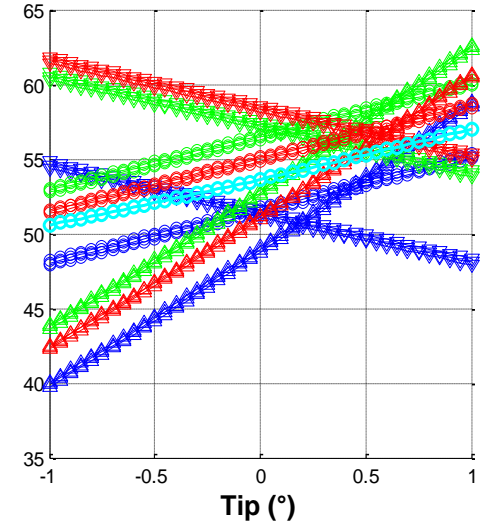
RMS spots VS. FOCUS for STEP #1



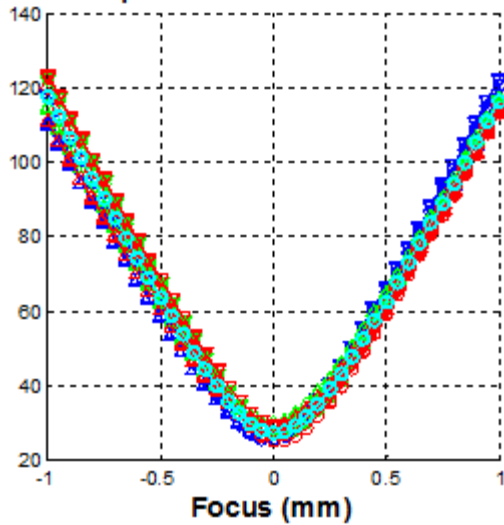
RMS spots VS. TILT for STEP #1



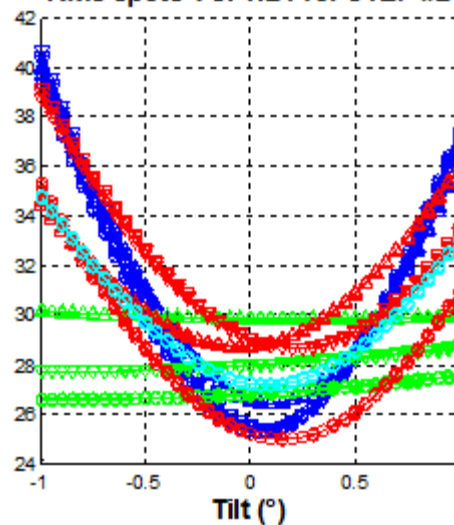
RMS spots VS. TIP for STEP #1



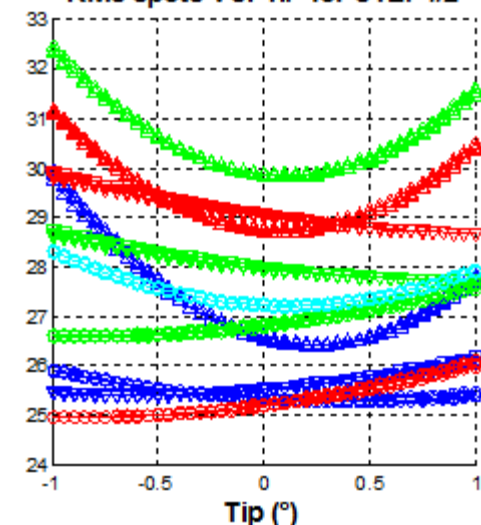
RMS spots VS. FOCUS for STEP #2

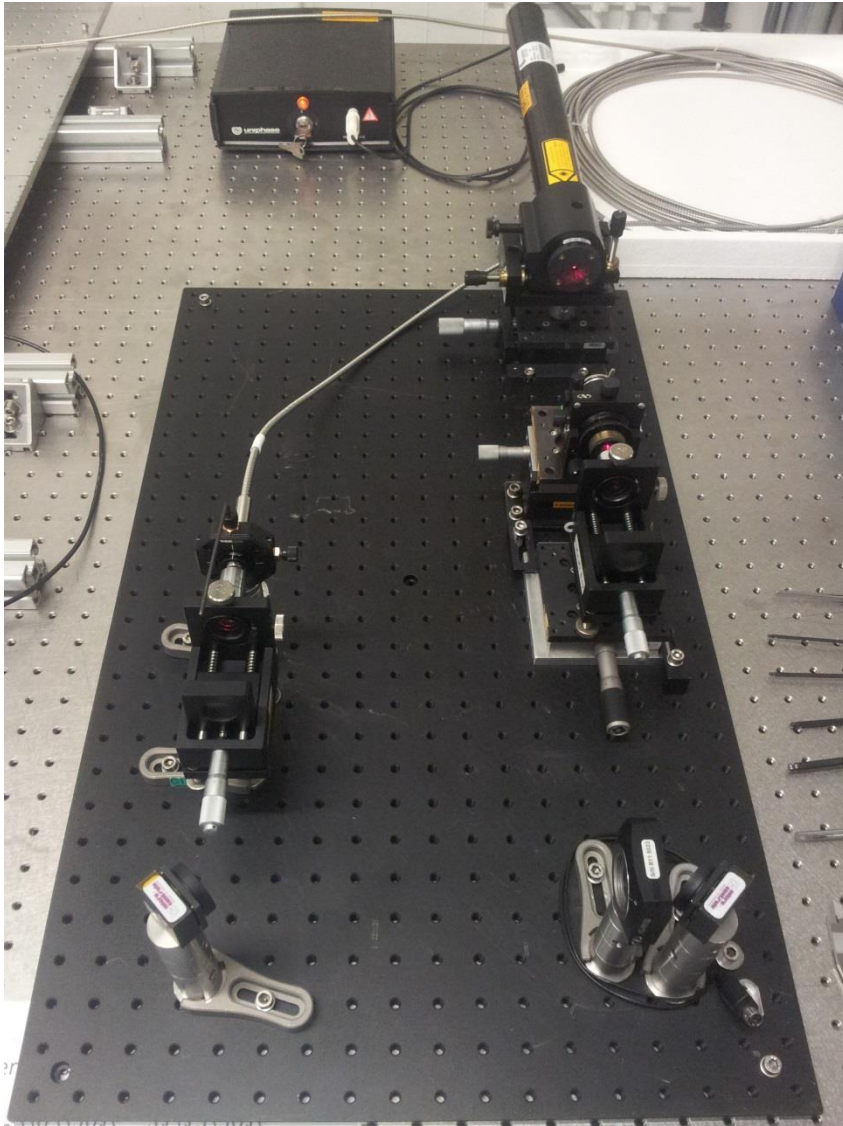


RMS spots VS. TILT for STEP #2

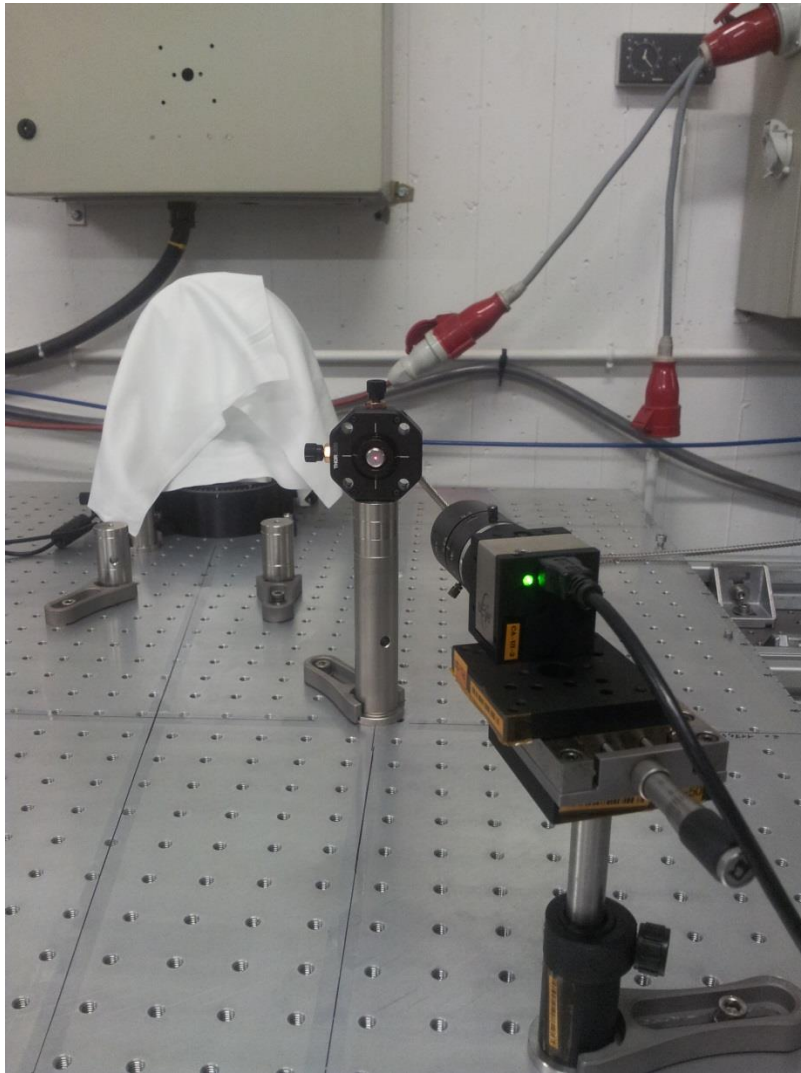


RMS spots VS. TIP for STEP #2

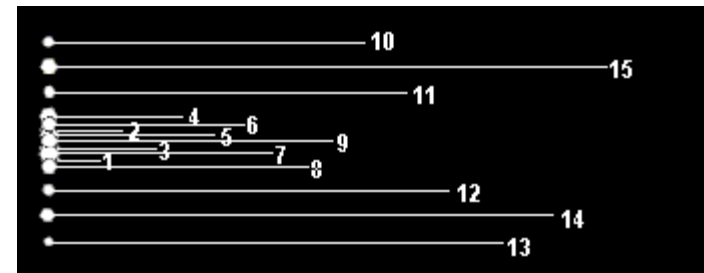


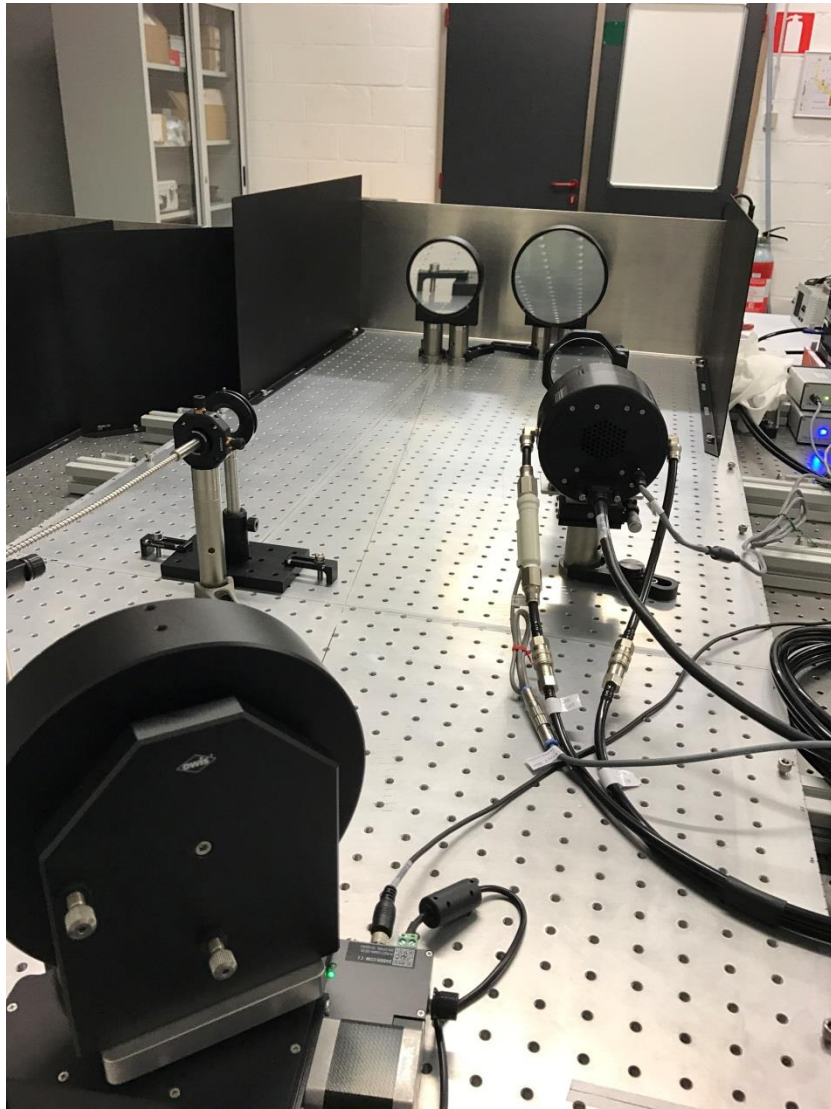


- Option 1:
 - Lasers (**HeNe** and **Nd:YAG**) purified by a spatial filter.
 - The output is modulated by polarizers.
 - A microscope objective injects the laser light beam into a selected fiber from the bundle
- Option 2:
 - U-Ne HCL directly illuminates the bundle entrance

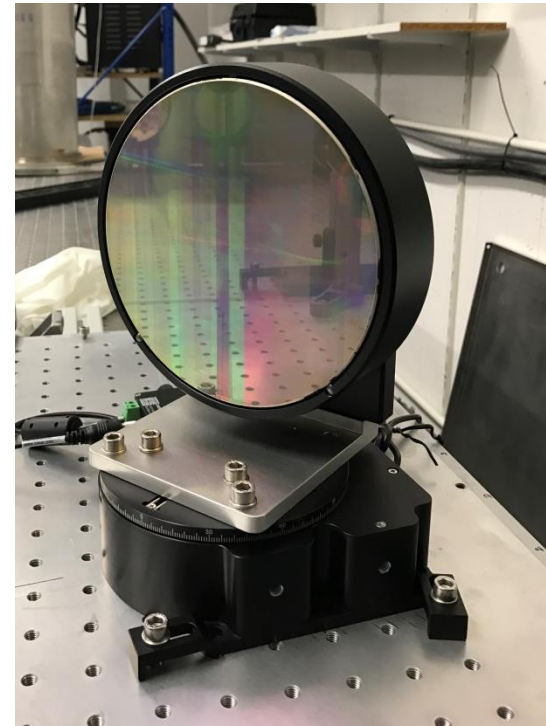


- **Identification of fibers:**
 - The output of the bundle is recorded with a camera
 - Fibers are lit one by one at the “telescope” side and a picture is taken each time.
 - This enables to identify the link between fibers at both sides of the bundle.



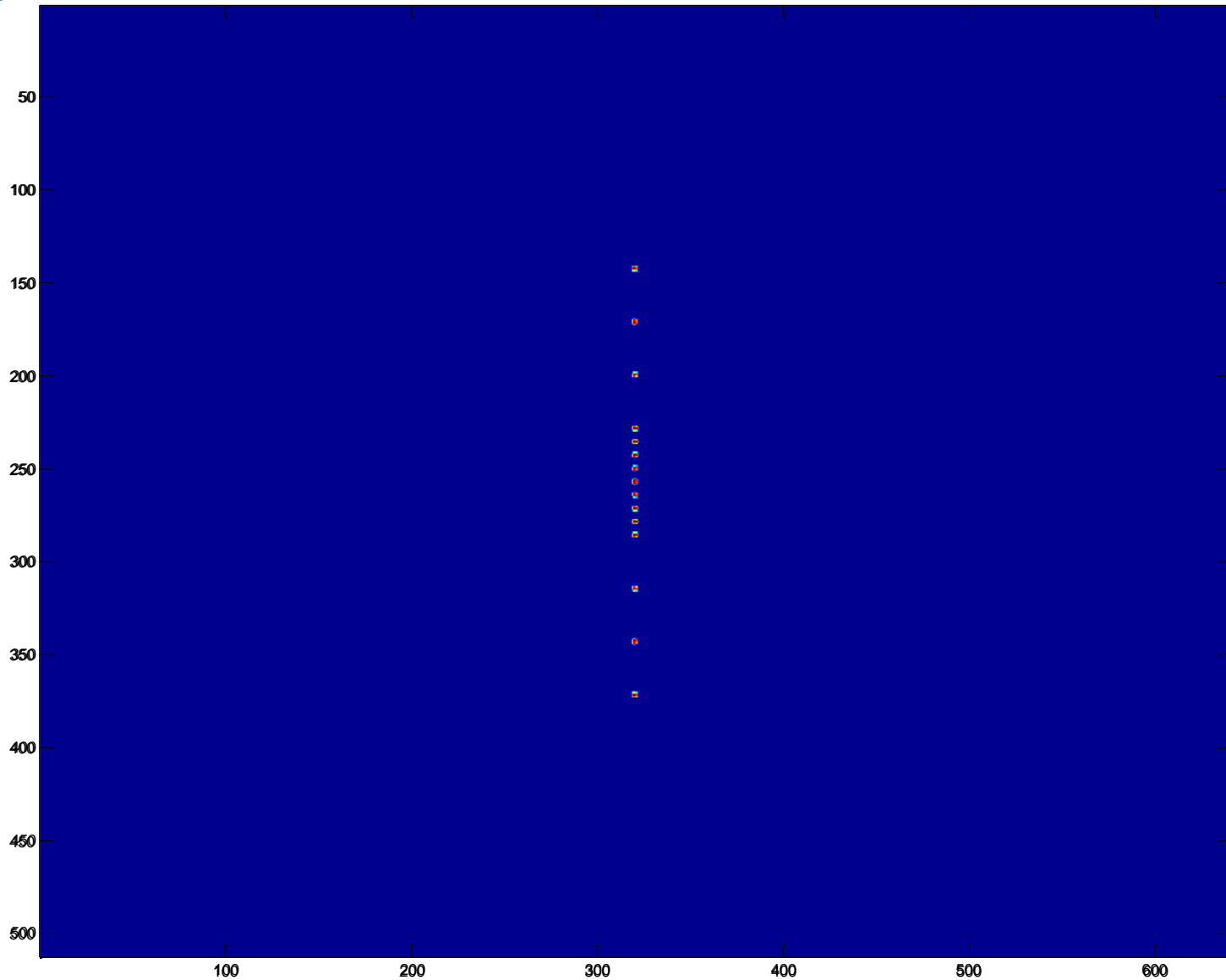


- Alignment status:
 - Main “Star” channel is aligned
 - Next step: calibration channels, SPS, ... and first light !





Alignment status – *First imaging quality results*

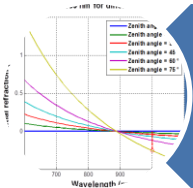




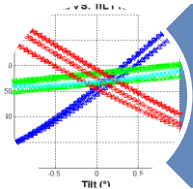
Conclusion



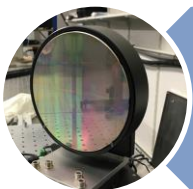
Investigated potential observations with smaller telescopes



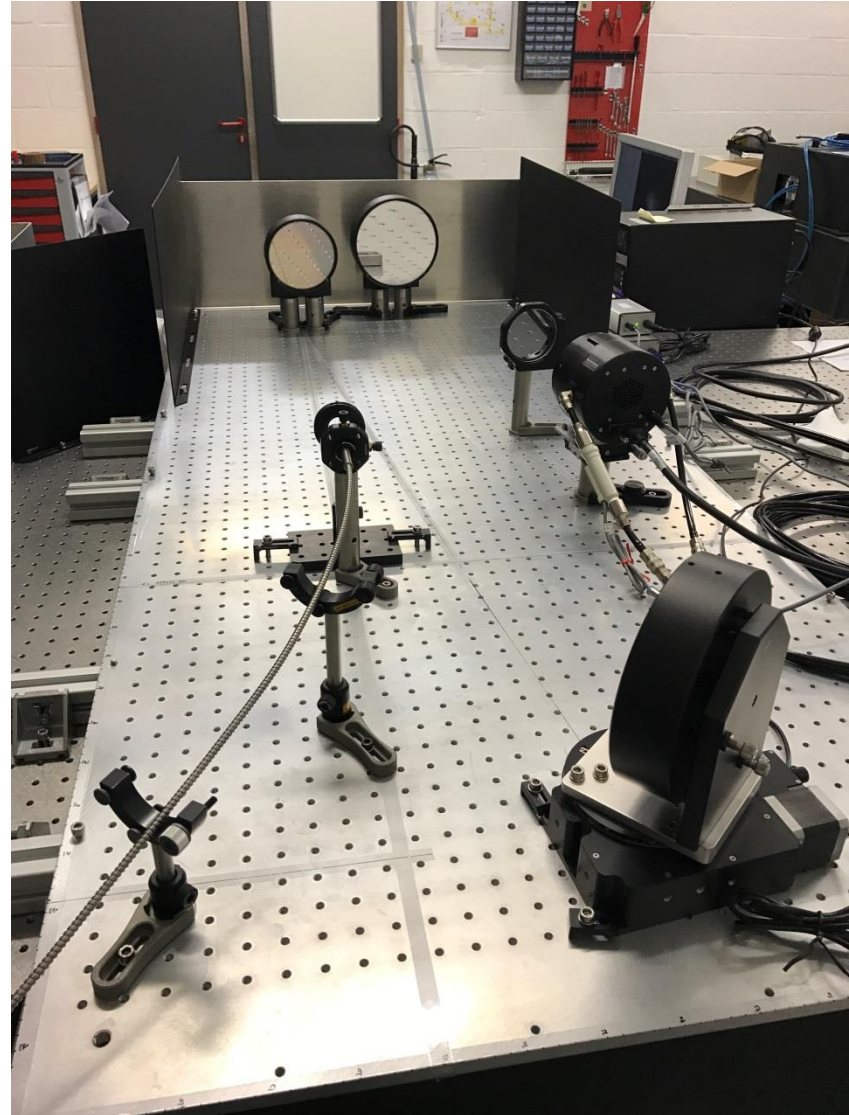
Pointing strategy revised



Simulated final alignment feasibility



Alignment: going on





Thank you for your attention.

Any question ?

